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PSYCHOLOGICAL AND EDUCATIONAL FACTORS IN TRANSFER OF TRAINING, PHASE I. QUARTERLY REPORT 5.

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DESCRIPTORS- *LEARNING PROCESSES, *TRANSFER OF TRAINING, *PSYCHOEDUCATIONAL PROCESSES, TASK PERFORMANCE, PROMPTING, CONCEPT FORMATION, MODELS, VERBAL LEARNING, TEACHING TECHNIQUES, LOGIC, RESEARCH PROJECTS, *COGNITIVE PROCESSES, *AUTOINSTRUCTIONAL METHODS, *PROGRAMED INSTRUCTION,

A STATUS REPORT WAS MADE OF THE ACTIVITIES PURSUED IN A 3-MONTH PORTION OF PHASE 1 OF A LARGER 10-YEAR PROJECT PLANNED TO STUDY THE PSYCHOLOGICAL AND EDUCATIONAL FACTORS INVOLVED IN TRANSFER OF TRAINING BY USE OF PROGRAMED SELF-INSTRUCTION PRESENTED BY TEACHING MACHINES. THIS MEDIUM WAS CHOSEN BECAUSE IT PROVIDES LABORATORY-LIKE CONDITIONS SUCH AS STABILIZED METHODS, STIMULUS CONTROL INCLUDING CONTROL OF TEACHER PERSONALITY, AND A STEP-BY-STEP RECORD OF THE STUDENT'S BEHAVIOR. REPORTS OF ONGOING PROJECTS AND THEIR CURRENT STATUS WERE PRESENTED. THEY WERE (1) A STUDY OF THE TRANSFER EFFECTS OF WRITTEN INSTRUCTIONS TO TASK PERFORMANCE AND OF TASK PERFORMANCE TO TASK PERFORMANCE, (2) LEARNING HOW TO LEARN UNDER SEVERAL CUE CONDITIONS, (3) THE EFFECTS OF SEQUENCE AND STRUCTURE ON COMPLEX CONCEPT FORMATION, (4) THE USE OF A MODEL AND A GENERAL PREVIEW TO FACILITATE THE LEARNING AND RETAINING OF COMPLEX SCIENTIFIC MATERIALS, (5) A STUDY OF TRANSFER EFFECTS OF VERBAL LEARNING, AND (6) EXPERIMENTAL ANALYSES OF THREE PATTERNS OF PRESENTING A STANDARD LOGIC TASK. (GD)

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PSYCHOLOGICAL AND EDUCATIONAL FACTORS IN TRANSFER OF TRAINING

Phase I

USOE Contract 2-20-003
Quarterly Report No. 5

AA000179

TRAINING RESEARCH LABORATORY

University of Illinois
Urbana, Illinois

PSYCHOLOGICAL AND EDUCATIONAL FACTORS IN TRANSFER OF TRAINING

Phase I

Quarterly Report No. 5

Period:

July 1, 1963 - September 30, 1963

Principal Investigator:

Lawrence M. Stolurow
Professor, Department of Psychology
Bureau of Educational Research

Project Sponsor:

Educational Media Branch
U. S. Office of Education
Title VII

Project No. 2-20-003

Chapter One

Nature of Project

General Purpose

This project is concerned with the psychological and educational factors in Transfer of Training. In spite of its importance and pervasiveness, transfer, as a psychological and educational process, has not been studied with the vigor and systematic determination that is required.

One of the potentially more important instructional media for efficient study of transfer of training is programed self-instruction using the teaching machine. This educational medium provides laboratory-like conditions such as stabilized methods, stimulus control including the control of teacher personality, plus a step-by-step record of the student's behavior. These recordings are an important source of data which can be used for the continuous improvement of the instruction. There is, therefore, an advantage to be gained from research on transfer of learning with this new concept of instruction. Such research could be particularly useful in contributing to the development of new psychological knowledge about school related instruction.

The background of thinking and research on transfer that is pertinent to the new media and, in particular to teaching machines and self-instructional programing needs to be summarized and evaluated. The theoretical positions of transfer such as the following need to be related to one another and to these developments in instruction: Thorndike and Woodworth's identical elements, the concept of mental discipline, current conceptions of mediation, and the

cybernetic theorizing grounded in models that include a feedback mechanism such as those of Simon, and of Miller, Gallanter, and Pribram.

Objectives

This proposal to study transfer is for a long range program to accomplish the following objectives in Phase I, the first two years.

The primary objectives of Phase I are: (1) to relate and crystalize existent information on transfer by determining its relationship to learning, problem solving, and individual differences in abilities and aptitudes, (2) to determine the implications of the existent knowledge for education and in particular for the educational media, (3) to conduct pilot empirical research on transfer, and (4) to prepare a research plan for Phase II.

Sub-goals for the project are to develop reports which (a) summarize and analyze the pertinent research, (b) examine theoretical issues and concepts, (c) analyze the relationships between transfer and learning, (d) study the relationships between transfer, abilities and aptitudes, and (e) examine the relationships between transfer and the development of cognitive structures and strategies.

It is anticipated that some comparative educational studies will be conducted to see if the principles derived from existent research can be used in educational settings where different cultural and/or language factors are operating. An effort will be made to conduct studies of cumulative transfer, longitudinal in nature.

General

1. Sample plan.

2. Treatments. Variations in the programs used for learning will probably include such treatment comparisons as (a) inductive vs. deductive, (b) cognitive grouping vs. spiral sequencing, (c) systematic deletion with terms constant vs. with terms varied. Reliable treatment effects will be re-examined to determine their potential generalizability by introducing cultural and language differences in groups. The initial studies will use programed materials in logic, mathematics and statistics since materials of this type are designed to teach cognitive structures that could have the widest possible transfer potential.

3. Controls. Programed instruction procedure employing printed texts, paper transport type of machine or a film device will be used as the means of presenting the treatments. Socio-economic and intellectual differences will be studied in relation to the intercultural and interlanguage differences and transfer effects of instructional strategies.

Data-types to be gathered and methods to be used

Two types of instruments will be used to measure performance: (a) written tests and (b) performance tasks. Evaluations will be made to determine the dimensions of transfer as well as to estimate the amount and direction of the effects. Some dimensions are: (a) learning new and related material,

(b) problem solving in which knowledge taught is directly relevant and sufficient, (c) problem solving where the knowledge is not necessary but the strategy required is relevant and useful, and (d) inferring and extending the knowledge taught to new materials.

Methods of statistical or other analysis

The analyses of variance will be used to determine the relative effects of the different treatments, and the correlational analyses will be used to determine the relationships between the ability measures and performance on the learning and transfer tasks.

Approximate time schedule

This proposal is to cover the work outlined above which will constitute Phase I of the 10-year program. Phase I is to take two calendar years (24 months).

Publication plans

The results of the studies completed in Phase I will be prepared as technical reports and possibly as monographs and articles.

LIST OF PERSONNEL

July 1, 1963 - September 30, 1963

Lawrence M. Stolurow -- principal investigator

Research Assistants	% Time	Period of Employment
Daniel Davis	25%	1 July - 30 September
Henry Lippert	50%	1 July - 30 September
James Zartman	25%	1 July - 30 September
Davis Suh	100%	1 July - 20 September
Eleanor Dobbins	25%	16 Sept - 30 September
Ellen Rosen	50%	16 Sept - 30 September

Clerical

Freda Blecher	50%	1 July - 30 September
Verna Vaughn	50%	1 July - 30 September
Dolores Fairbanks	50%	1 July - 30 September

Hourly

Valerie Anderson		1 July - 30 September
Richard McNabb		1 July - 30 September

Chapter Two

Study of the Transfer Effects of Written Instructions to Task Performance and of Task Performance to Task Performance

L. M. Stolurow and T. J. McHale

A series of three studies which investigated the effects of various types of transfer in concept-formation tasks were conducted. Only two different tasks were used, and they were different only in minor aspects since each was generated from the same multiple-correlational model (See Azuma, 1960; Cronbach and Azuma, 1961, A & B). Two basic types of transfer were studied: (1) transfer to task performance from written instructions giving various amounts of information, and (2) transfer from one task to the other where the relationships between tasks are specified.

Experiment I

Amount of Information Conveyed by a Knowledge of Either the Principle or Cues Given in Algebraic or Geometric Form

Status: Data in process

Purpose

Pilot work suggested that information about the task principle is no better than no information, whereas information about the critical cues does facilitate performance. Furthermore, in a written questionnaire administered at the end of the task, many Ss verbalized a geometric approach to the solution of the task, whereas the original information was given in algebraic form. These verbalizations suggested that information given in algebraic form would be more beneficial since the geometric approach seemed a more natural way to attack the problem.

Hypotheses

The following specific hypotheses were tested:

1. The rank-order of performance will be (a) full-information, (b) cue-information, (c) principle information and no information.

2. Whenever two groups are given the same information in different form, the group given the information geometrically will perform better than the group given the information algebraically.

3. Though cue-information will lead to better overall group performance than principle-information, a knowledge of the principle is a requisite for criterion performance. Therefore, more Ss in the principle-groups than in the cue-groups will attain criterion performance.

Task stimuli. Each stimulus presentation consisted of a 2.5 inch by 2.5 inch square with a small red cross and a small green cross drawn inside it. The left side of the square and the bottom of the square represent coordinate axes. The location of each cross is specified by its distance from the left side and the bottom of the square. These distances are its coordinates.

In the task stimuli, each of the four coordinates, x', y', x'', and y'', may take on one of four values, 3, 6, 9, or 12. These four values correspond to actual distances of .5, 1.0, 1.5 and 2.0 inches. The number of possible combinations of the coordinate values is 4^4, or 256. However, since the crosses were not allowed to occupy the same location in any stimulus presentation, only 240 (16 x 15) combinations were actually possible. Not all of these possible stimuli were used.

Presentation of stimuli. Stimuli were presented in a booklet, each page showing six different stimuli. The booklet consisted of 160 stimuli or trials. Subjects responded by marking with an X one of 10 possible response categories. On the answer sheet there were 10 numbers for each trial, one number for each of the 10 possible numerical answers. An X was drawn through the appropriate number. Subjects were allowed 20 seconds for each trial, and verbal feedback was given at the end of each trial.

The 160 learning trials can be considered as 10 sets of 16 presentations each. Within each set of 16 possible combinations of x' and x'' appear once each. This automatically made $r_{x'x''}=.00$. The distributions of y' and y'' were very close to rectangular. $r_{x'y'}$, $r_{x''y'}$, and $r_{x''y''}$ did not exceed .12 in any block. Thus, for practical purposes these variables can be considered to be uncorrelated.

Criterion k. The formula used by E to define the correct response k is $(2x' + x'')/3$. Since x', y', x'', and y'' are uncorrelated within our set of stimuli, the definition of k determined their validities as follows: $r_{x'k}=.89$, $r_{x''k}=.45$, $r_{y'k}=.00$. Though the actual correlations of x' and x'' with k vary between -.12 and +.12. Since the 10 discrete response categories are exact numerical answers, S had to use precisely a 2:1 weighting to receive 100% reinforcement.

Measure of performance. The basic measures of performance were the criterialities* of the individual cues and of the construct k: product-moment correlations coefficients of the actual responses of each S with the responses he

would give if he were to make his judgments solely in terms of x', x'', y', y'', or k. This yields a 5 x 5 matrix of correlations for each S: rows for x', x'', y', y'', and k; columns for each block of 32 trials which were analyzed separately. Correlations were computed over blocks of 32 trials -- 1-32, 33-64, 65-96, 97-128, 129-160.

Subjects. The Ss were college students from the University of Illinois from the introductory psychology class. Their participationwas the class requirement. The task was administered to Ss in groups that ranged in size from 3 to 20. With the larger groups, at least two, and sometimes three, Es helped with the admin istration. There were 15 Ss in each experimental group for a total of 120 Ss.

Experimental Design

There were seven groups in the basic design of this study. (An eighth group was run in an auxiliary experiment which will be discussed.) There was a no-information group as a control, and two sets of principle-, cue-, and full-information groups. One set was given information in algebraic form; the other in geometric form. This design allowed a comparison of principle- vs. cue-information, and algebraic vs. geometric information.

Results

The correlational analysis of the data has been completed, but statistical analyses of the questionnaire data has not yet been completed. The statistical analyses which have been completed lead to the following conclusions about the

*Criteriality according to Bruner (1956) means how much a cue is actually used by an S.

experimental hypotheses:

1. The predicted rank-order order of performance was confirmed. That is, full-information was best, then cue-information, and there were no major differences between the principle-information and no-information groups.

2. There were no overall differences between the geometric and algebraic information groups. However, the geometric groups tended to do a little better with full- and cue-information and a little worse with principle-information. None of these differences was significant.

3. The hypothesis that there would be more solvers in the principle groups than in the cue groups was not confirmed. This failure of confirmation is related to the overall superiority of performance of the cue-groups.

Experiment 2

A Comparison of Transfer Effects From Written Instructions Under Paced and Self-Paced Conditions

Purpose

This study is basically a replication of some of the groups in Experiment 1. The main difference is that in this experiment, each subject worked at a teaching machine and consequently was self-paced. Comparisons were therefore possible between a paced and a self-paced condition, with major emphasis on two variables: (1) trials to criterion, and (2) time to criterion.

Hypotheses

The following specific hypotheses were tested:

(1) Since the self-paced condition allows each subject to proceed more slowly in the early trials when time to think is more necessary, subjects in

this study should attain criterion performance in fewer trials than comparable subjects in Experiment 1.

(2) Time to criterion should also be facilitated in the self-paced condition, though the difference between pacing and self-pacing should not be as large here as in trials to criterion.

Task stimuli. Only one minor change distinguishes the task stimuli from those of Experiment 1. Instead of using red and green crosses, the red cross was replaced by a black circle and the green cross by a black cross. These changes facilitated filming for the teaching machine, and also eliminated the difficulty encountered by color-blind subjects.

Presentation of stimuli. Stimuli were presented on a teaching machine. Only one stimulus frame was seen at a time by the subject; the correct answer for each frame was given on the following frame. The subject could return only to the immediately prior frame to investigate any discrepancy between his answer and the correct answer. Therefore, the presentation of stimuli was equivalent to a straight linear program.

Subjects. The subjects were college students from the University of Illinois from an introductory psychology class. Their participation was a class requirement. Subjects were run in groups of not more than five each. There were 15 subjects in each experimental group for a total of 60 subjects.

Experimental design. There were six experimental groups in this study; three of the four were replications of the no-information and full-information

(both algebraic and geometric) groups of Experiment 1. The fourth group, also a full-information group, is comparable to the column-group in Experiment 3. The fifth and sixth groups are cue and principle groups for whom the information is given in terms of the column-group's model.

Results

Not all of the subjects have as yet been run. Enough subjects to complete the design will be run during the next month.

Experiment 3

Various Aspects of Transfer from One Task to Another Generated From the Same Model

Purpose

In Experiment 1, the subjects who solved the task verbalized their solutions in various ways that seemed to be systematically related to the type of instructions they had been given. These verbalizations ranged from the general and abstract to a very task specific rule. Intuitively, transfer from solution to the first task to another generated from the same model would seem to be facilitated by a less task specific and more generalizable mediating rule. This study was designed to test whether differences in transferability of training can be demonstrated on the basis of verbalizable mediating rules even though all subjects have solved the training task. It was designed to show, therefore, that solution of the training task is not as relevant to transfer as a subject's verbalizable solution of the training task. It was also designed to study the transfer effects of various perceptual elements from a first to a second task.

Hypotheses

The following specific hypotheses were tested:

(1) By comparing the mediating rules used by the subjects in Task 1 with the mediating rule they must attain to solve Task 2, rank-order predictions of the speed of solving Task 2 can be made.

(2) Perceptual similarity of the cues in each task should lead to faster solution of Task 2 than perceptual dissimilarity of the cues.

(3) When the stimuli of two tasks are not obviously similar so that the subjects will not automatically suspect that the two tasks might be related, instructions stating that the two tasks are related should facilitate the speed of solution of Task 2. This facilitation should occur over and above any other transfer effects that might be found.

Task stimuli. The training task in this study was the same as the task used in Experiments 1 and 2. The only change was the use of a small black circle and a small black square within each stimulus. The transfer task used a 3 x 5 stimulus cards on which a circle, square, rhombus, and triangle appeared. Either the number 1, 2, 3, or 4 appeared within each geometrical figure. The numbers within the figures replaced the four coordinates used in the training task. Only two of the four figures were relevant; the correct rule to obtain k (criterion response) was 2(number in the circle) + 1 (number in the square) for some subjects, 2 (number in the triangle) + 1 (number in the rhombus) for others.

Presentation of stimuli. After the subject read one of three sets of full-instructions, he was given stimuli for Task 1 by the experimenter one at a time. The subject gave his numerical response and the rule he was using on each trial in both tasks. After attaining criterion in the training task, E switched the formula by reversing the weightings of the two relevant cues. The same type of switch was made in the transfer task. In neither task was the subject informed that a switch was being made, nor was he allowed to ask questions of E at this time. This switching of rules was done to investigate two phenomena: (1) transfer from one task to a perceptually similar task, (2) the equivalence of two simultaneous reversal shifts administered to the same subjects in the same experimental situation. After solving the first task and its accompanying switch, the subject was read the instructions for Task 2 and began it immediately.

Experimental design. Three sets of instructions were: (1) full-information algebraic, (2) full-information column [k = 2(column number of the circle) + 1(row number of the square)]. The three sets of instructions were suggested by verbalizations of the subjects in Experiment 1. The three types of transfer tasks were differentiated by (1) correct formula, and (2) knowledge of the relatedness of the two tasks. There were two types of correct formula: (1) 2(number in circle) + 1(number in square), (2) 2(number in triangle) + 1(number in rhombus). The third group, also given Formula 1, was told that the training and transfer tasks were related.

Subjects. Five subjects were run in each cell for a total of 45 subjects. This number may be doubled to allow a comparison of individual cells besides the comparison of rows and columns. A control group of 10 subjects was also needed. This group was allowed to warm-up on a neutral card-sorting task and then attempted to solve Task 2. Half of these subjects had to discover Formula 1; half had to discover Formula 2.

Results. Forty-five experimental subjects have been run in this study. The control subjects will be run during the next month.

Chapter Three

Learning How to Learn Under Several Cue Conditions

Dale Mattson*

Status: COMPLETED--See Technical Report No. 1**

Purpose

This was an experimental study with two major purposes. The first objective was to determine the effects of several kinds of training on the subsequent mastery of a modified form of a problem solving task developed by Azuma (1960). The second major purpose was to evaluate the usefulness of cue-response criterialities in explaining transfer effects.

Hypotheses

1. Three kinds of transfer effects can be identifed and compared: an effect associated with cue repetition, a learning-to-learn effect, and a warm-up effect.

2. Cue repetition is expected to result in a negative effect under a condition similar to a nonreversal shift (relevant cues during training become irrelevant during the criterion task) and a positive effect under a condition in which the same cues are relevant for training task and criterion task.

3. On the first trial of the transfer task, single-trial criterialities will be higher for cues previously relevant than for cues previously irrelevant.

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*This study was done in partial fulfillment of the requirements for a Ph. D. degree.

**Mattson, Dale. Learning How to Learn Under Several Cue Conditions. Technical Report No. 1, August, 1963.

Method

Design. The design of this study was a factorial design involving two degrees of similarity between training tasks and the criterion task, and three degrees of similarity between the cues used for the training task and those used for the criterion task. In addition to the six groups (16 Ss per group) necessary for this design, an additional group of 16 Ss was used as a control group. These control Ss performed only the criterion task. The entire experiment was duplicated--once using large group testing procedures and once testing groups of either 7 or 14 at a time.

Subjects. The Ss for this experiment were all undergraduate college students. For the first experiment in which large group testing procedures were used the Ss participated in the experiment as a part of a course requirement either in psychology or in educational psychology. For the second experiment all Ss volunteered to take part.

Results

The results of the study may be summarized as follows:

1. A learning to learn effect was identified. Those Ss that received training on a series of training tasks similar to the criterion task solved the criterion task in fewer trials than Ss for whom training tasks were not similar to the criterion task.

2. No transfer effect was found for the similarity of cues between the training tasks and the criterion task. For some Ss relevant and irrelevant

cues remained constant for all tasks; for some Ss relevant and irrelevant cues were reversed on the criterion task; and for some Ss completely new cues were introduced during the criterion task. The number of trials needed to solve the criterion task was not affected by any of these three cue conditions.

3. A warm-up effect was identified. Subjects who performed a series of four tasks quite different from the criterion task, using four cues unlike those used on the criterion tasks solved the criterion task in fewer trials than Ss in a control group.

4. The use of the same two cues in the solution of a number of training tasks resulted in an increased use of these cues on the first trial of the criterion task. The criteriality (correlation) between cues and responses was higher on the first trial of the criterion task for cues which had previously been relevant than for cues which had been irrelevant.

Since no differences were found between experiments for all tables data from both experiments was combined.

Chapter Four

The Effects of Sequence and Structure on Complex Concept Formation

Daniel Davis

Status: The analyses of this experiment is in the final stages of completion. Some of the main results are reported here. The detailed analyses and discussion will appear in the next report.

BACKGROUND

Consider a concept formation task in which there are two cues which are relevant to the solution and two cues which are not. Also, of the two cues which are relevent, one is more relevant than the other. That is, solutions based only on the more relevant cue will be closer to the correct solution than those based only on the less relevant one.

For such a task it has been found that subjects can learn the relevance of stimulus parameters simultaneously. Through selective reinforcement they learn to ignore the irrelevant cues and to correctly weight and combine the relevant cues into a complex concept (Azuma, 1960; McHale and Stolurow, 1962).

For a similar task in which there was one relevant cue and two irrelevant cues, Detambel and Stolurow (1956) showed that sequencing is an important factor in the effectiveness of training. In particular, great improvement results when the following conditions are met:

a. When the value of the relevant cue changes on adjacent trials, the values of the irrelevant cues remain fixed.

b. When the value of one or both of the irrelevant cues changes, the value of the relevant cue remains fixed.

The above conditions determined what they called "asynchronous trials" as compared to "synchronous trials" in which all cues were free to vary simultaneously.

In this study several ways of structuring and sequencing the early trials of a complex concept formation task were compared. The comparison was made on the basis of transfer to later trials which were completely unstructured or synchronous.

The training trials were divided into two main segments:

1. Asynchronous segment (A)--one relevant and one irrelevant cue were held constant while one relevant and one irrelevant cue were free to vary.

2. Synchronous segment (S)--all cues were free to vary.

The asynchronous segment was divided into two parts:

1. MAX. --The more relevant cue was free to vary.

2. MIN. --The less relevant cue was free to vary.

The four possible orders of presenting the above conditions were compared with each other and with a control condition in which only synchronous trials were given during training. The purpose of this was to obtain answers to the following questions:

1. What is the effect of adding the asynchronous trials?

Based on the study of Detambel and Stolurow it is expected that during training the asynchronous groups should do better, but it is not at all certain that they will transfer to the synchronous situation. Whether they do or not would seem to depend on how they form the concept. If they operate on each cue independently and then combine them, there should be positive transfer. The reason for this is that on asynchronous trials they can direct all their attention to one cue at a time and later try to combine them. If, on the other hand, they use relationships between the cues, the asynchronous trials should be of no help.

2. What is the best order of presentation of the asynchronous (A) and synchronous (S) training trials?

It is expected that the order S-A is better than A-S. In the former case, the subject is familiarized with the situation to which he must eventually transfer. Therefore, on the A-trials he has a reference on which to base his hypotheses.

3. During the asynchronous trials is it better to present the more relevant cue varying first?

Based on some preliminary work there are indications that the MAX-MIN order is better than MIN-MAX. The subject can account for more of the variation of the solution during the MAX. condition, and, it seems easier to build a complex concept when most of the variation is explained by the main construct.

Task

The task used is the same as the one used by McHale and Stolurow in their 1962 report. Since the materials used and method of presentation are the same, they will

not be described in detail here. The stimuli consist of a red cross and a green cross presented in 2.5 inch 2.5 inch squares. Each cross can appear in four horizontal and four vertical positions. The two relevant cues are the horizontal positions of the crosses and the irrelevant cues are their vertical positions. The concept 'k' is defined as follows:

$$k = \frac{2x' + x''}{3}$$

where: x' is the horizontal position of the red cross
x'' is the horiziontal position of the green cross
The positions are valued 3, 6, 9, and 12.

In this case the position of the red cross is weighted twice as much as that of the green cross.

Procedure

Each group was given 160 presentations in five blocks of 32 trials. The first two blocks were the training trials and the last three were the task trials. The 32 asynchronous trials consisted of 16 A-MAX trials and 16 A-MIN trials. The procedure is outlined in Table 1.

The following additional instruction was given prior to the two types of asynchronous trials: "On the following presentations the red (green) cross will always appear in the same position. Therefore, changes in the value of 'k' will be caused by changes in the position of the green (red) cross."

Table 1

Experimental Procedure

	Training		Task
	(1-32)	(33-64)	65-160)
Exp. 1	A(MIN-MAX)	S	S
Exp. 2	A(MAX-MIN)	S	S
Exp. 3	S	A(MIN-MAX)	S
Exp. 4	S	A(MAX-MIN)	S
Control	S	S	S

Subjects

Subjects were taken from the Introductory Psychology course at the University of Illinois. There were 11 subjects in each treatment.

Results

The Pearson product-moment correlations of each subject's scores with each of the criteria (k, x', x'', y', y'') were calculated for the four synchronous blocks and the two parts of the asynchronous block. For the purposes of analysis these were converted to Z' scores which are distributed in approximately normal form:

$$Z' = 1/2 (\log_e (1 + r) - \log_e (1 - r))$$

The learning curves for the experimental groups and the control groups are shown in Figure 1. These were obtained by averaging the Z' scores and reconverting to correlations. The value for the asynchronous blocks is the average of the values for the A-MAX and A-MIN portions.

The experimental groups were compared using a 2 x 2 x 3 factorial design. The first factor involves the S-A vs A-S order comparison while the second involves the MAX-MIN vs. MIN-MAX order comparison. The third involves the blocks factor which has the task blocks as its three levels. The analyses followed the procedure of Wimer (1962) for a three-factor experiment with repeated measures on one factor.

The summary table is show in Table 2. No interactions were significant while the main effects of MAX-MIN order and trial blocks were significant.

Discussion

The results indicate that the groups which were given the synchronous training first did not make better use of the asynchronous trials then the group which were given asynchronous training initially. This seems to contradict other findings for tasks of the discovery type and will be discussed in detail in the full report.

The finding that the MAX-MIN groups learned faster than the MIN-MAX groups indicates that the order of training in complex tasks should proceed from the most pertinent variables to the least pertinent variables.

The full analysis of this study will be presented in the next report.

Figure 1 A: Average Criterialities of the (A-S) Groups and the Control Group

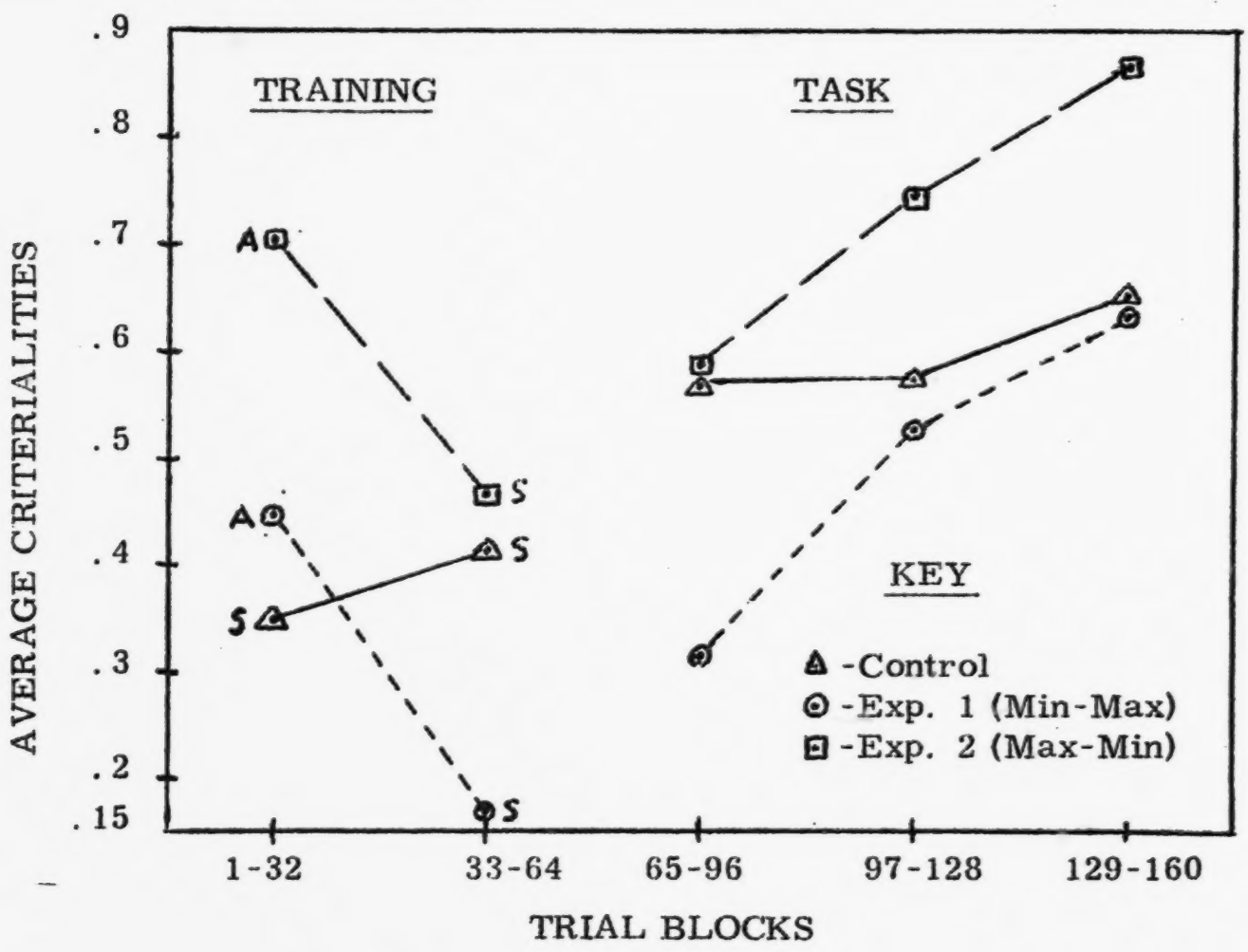

Figure 1 B: Average Criterialities of The (S-A) Groups and the Control Group

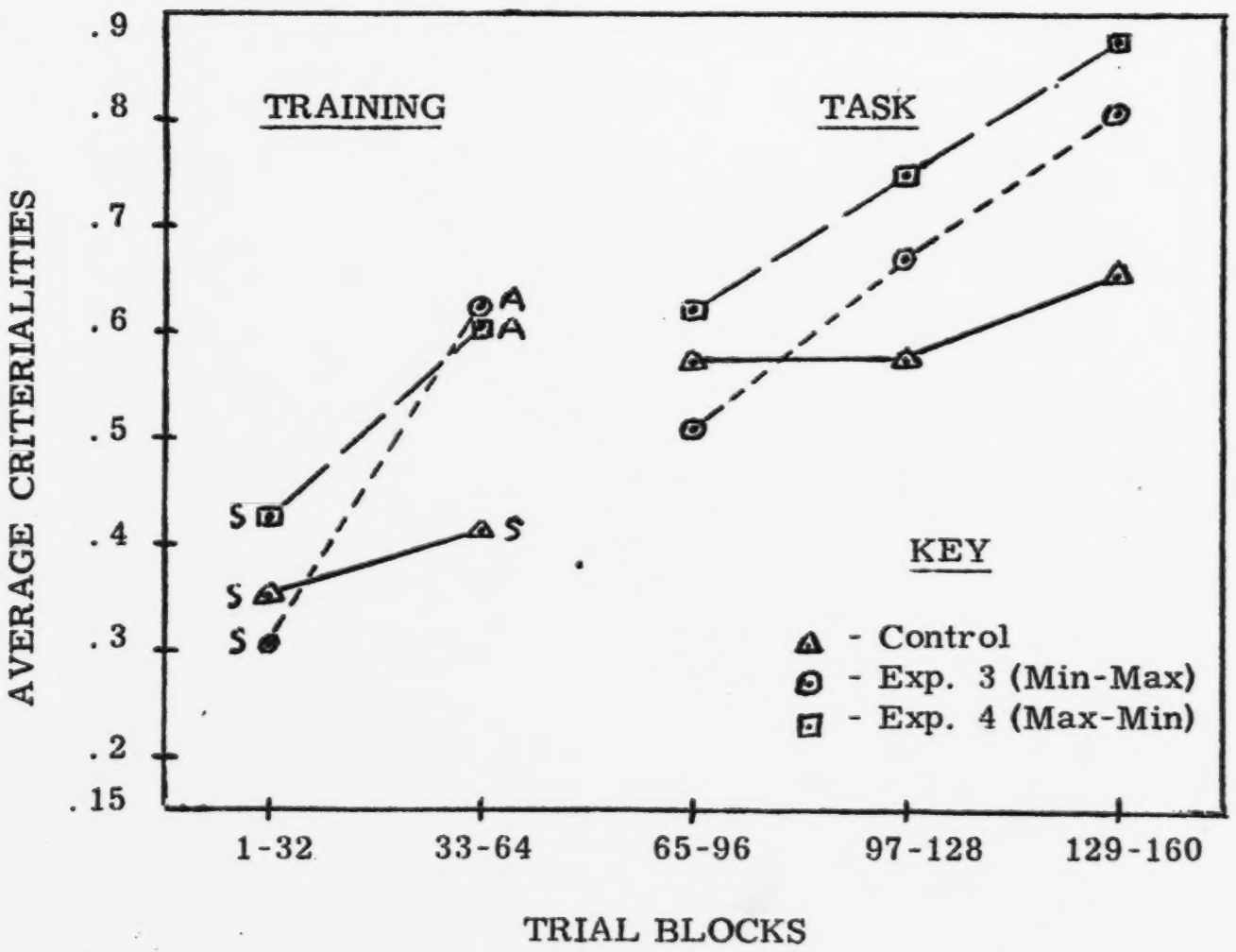

Table 2

Summary of Analysis of Variance
of Task Scores for the
Experimental Groups[a]

Source	SS	d.f.	MS	F
Between Subjects	33.383	43		
A(S-A Order)	.858	1	.858	1.188
B(MAX-MIN Order)	3.180	1	3.180	4.404[b]
A X B	.447	1	.447	.619
Subj. within grps.	28.898	40	.722	
Within Subjects	18.112	88		
C(Trial Blocks)	6.781	2	3.391	24.396[c]
A X C	.050	2	.025	.180
B X C	.162	2	.081	.583
A X B X C	.021	2	.021	.079
C X Subj. within a groups	11.098	80	.139	

aThe K-criterialities were transformed to Fisher-Z scores for this analysis.

b$F_{.95}(1, 40) = 4.08$

c$F_{.99}(2, 80) = 4.92$

Chapter Five

The Use of a Model and a Generalized Preview to Facilitate the Learning and Retaining of Complex Scientific Materials

M. David Merrill*

Status: COMPLETE (Will be a forthcoming Technical Report)

Based on Ausubel's Subsumption theory and its implications for the use of advance organizers, it is hypothesized that presenting a model and/or a preview prior to the presentation of complex verbal materials will facilitate the learning and retention of those materials.

In Experiment I four groups of high school students were divided into high and low IQ groups. Group I was presented a model and a preview prior to learning a complex imaginary science; Group II was presented the model prior to the science and received a review in place of a preview; Group III was presented a preview prior to the science; and Group IV was presented only review but no model or preview. The mode of presentation was programed booklets. Students were tested both immediately after completing the program and after two weeks.

In Experiment II two groups of college students learned the materials that were learned by Groups I and IV in Experiment I. The mode of instruction was by Min/max teaching machine. The subjects were tested immediately following learning.

Results indicated no significant main effects; there were the following significant interaction effects: (a) Retention as measured by Application items was best for high IQ students when presented a model but best for less gifted

*This study was done in partial fulfillment of the requirements for a Master of Science degree in Education.

students when no model was presented; (b) Retention as measured by Taught Knowledge items was best when no model or preview was presented and poorest when only a model but no preview was presented. It was suggested that one would want to obtain evidence of better understanding on the part of the students before one would be justified in failing to reject the null hypothesis.

Chapter Six

A Study of Transfer Effects of Verbal Learning

Lawrence M. Stolurow and George E. Brehman

Status: Data being collected

Problem

An experiment on transfer and retroaction has been designed and will be carried out during the Fall.

Purpose

The experiment is to test two hypotheses. One is that the serial learning of a list of words (list B) is facilitated if a particular list has been learned previously (list A)--a list composed of words each of which has a high probability of being an elicitor of the word in the corresponding position on the second list to be learned (list B). A second hypothesis concerns bidirectional associates, words for the two lists that associate highly with one another in either direction, i.e., A, as the cue elicitor B, as response, and B, as cue elicits A, as response for example, in the Kent-Rosanoff list. The hypothesis to be tested is that the recall of the first list following the interpolated learning of the second list will be facilitated whenever the order of the bidirectional associates correspond in the two lists. Thus, with one group they will be learned in the corresponding order and in the other group they will not.

Thus, control will be achieved by changing the order of the experimental A list so that the words in corresponding positions in the two lists are no longer associational matches but are still the same words..

Achievement was significantly lower for the unreinforced group on a logic test given in the middle of the learning experience. Although no significant differences were observed on a posttest of logic, the differences between means were in the same direction as on the midtest.

A significant interaction effect was observed between positive and negative social reinforcers on both the midtest of logic and attitude toward the program experience. Results indicated that negative reinforcement was more effective than positive reinforcement in changing logic performance. These results confirm previous data obtained in conventional learning tasks.

Attitude

There was no difference between the treatment groups on attitude toward programed materials after the learning experience; however, there was a significant difference on attitude toward the immediate learning experience. The group which received both positive and negative reinforcers had the lowest opinion (attitude) of the learning experience.

Attitude toward programed materials improved significantly for all groups with the program experience.

There was a significant correlation between attitude and performance in the task for all groups.

Personality Variables

There was a significant relation between scholastic aptitude test scores and the need for achievement.

Intraception was negatively correlated with speed and efficiency over all groups, and thus served as a generally effective personality variable. It was also related to high attitude under maximum social reinforcement conditions (both positive and negative reinforcement).

High deference was not related to achivement performance, but led to lower attitude under punitive conditions. *

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*This study was given auxiliary publication as Technical Report No. 11, Office of Naval Research Contract Nonr 1834-36.

Chapter Seven

Experimental Analyses of Three Patterns of Presenting a Standard Logic Task

Lawrence T. Frase, Lawrence M. Stolurow, and David Suh

Status: The data for the design sketched below have been collected and are in the process of being analyzed.

Purposes

To study some specific ways in which the learning of logic transfers to problem solving (as defined by application test items).

Design

The patterns of presentation of the logic program are the independent variables to be investigated in relation to learning and transfer.

Programing Pattern (Main Treatments)

Maximum Linear								Minimum Linear								Branching							
Books								Books								Books							
II							III	II							III	II							III
								Dependent Variables															
1	2	3	4	5	6	*		1	2	3	4	5	6			1	2	3	4	5	6		

The analysis is further subdivided according to application and knowledge items. The analysis of variance and correlational techniques are being used.

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*The arabic numerals 1, 2, 3, 4, 5, and 6 represent the following respective measures; pretest scores on knowledge and application of logic; errors made in the program; scores on a review test; scores on a posttest of logic; the gains made in application (pretest/posttest differences); the gains made in knowledge (pretest/posttest differences).

Chapter Eight

List of Articles Abstracted

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